

ATTACHMENT A

CLEAN COPY OF PENDING CLAIMS (AS OF DATE OF RESPONSE)

1. A substrate comprising:  
a base substrate;  
an interfacial bonding layer disposed on the base substrate; and  
a thin film adaptive crystalline layer disposed on the interfacial bonding layer, wherein:  
the interfacial bonding layer is solid at approximately room temperature, and in liquid-like form when above room temperature;  
the thin film adaptive crystalline layer has a degree of flexibility to expand or contract its lattice constant along a direction parallel to a surface of the substrate when the interfacial bonding layer is in liquid-like form; and  
the base substrate is mechanically strong enough to support the interfacial bonding layer and the thin film adaptive crystalline layer thereon.
2. The substrate of claim 1, wherein the thin film adaptive crystalline layer comprises approximately the same crystalline lattice structure as  $\text{In}_x(\text{Al}_y\text{Ga}_{1-y})_{1-x}\text{As}$ , wherein  $x$  is approximately 15% to approximately 45%.
3. The substrate of claim 1, wherein the substrate comprises a substrate for formation of a vertical cavity surface emitting laser based on  $\text{In}_x(\text{Al}_y\text{Ga}_{1-y})_{1-x}\text{As}$ .
4. The substrate of claim 3, wherein  $x$  is approximately 15% to approximately 45%.
5. The substrate of claim 1, wherein above room temperature comprises a temperature of approximately 80°C to approximately 600°C.
6. (once amended) The substrate of claim 1, wherein the thin film adaptive crystalline layer comprises InGaAs with an In composition between approximately 15% and approximately

45%.

7. The substrate of claim 1, wherein the thin film adaptive crystalline layer comprises a compound semiconductor.

8. The substrate of claim 5, wherein the compound semiconductor comprises InP, GaAs, GaSb, or InAs.

9. The substrate of claim 1, wherein the base substrate comprises a semiconductor, an inorganic material, a metal, or a combination thereof.

10. The substrate of claim 9, wherein the semiconductor comprises GaAs, InP, GaP, Si or Ge, wherein the inorganic material comprises sapphire, poly-crystalline BN, or ceramics, and wherein the metal comprises Bi, In, Pb, Sn, Al, Ni, or metal alloy.

11. The substrate of claim 1, wherein the interfacial bonding layer comprises a single layer of the same material, or multiple layers of different materials.

12. (once amended) The substrate of claim 11, wherein the single layer of the same material or the multiple layers of different materials comprise

Bi, In, Pb, Sn, Al, or Ni; or  
a metal alloy; or  
inorganic materials.

13. The substrate of claim 1, wherein the interfacial bonding layer comprises multiple thin metal films, wherein some of the films comprise liquid-like form at a temperature above room temperature, and some of the films remain solid at the temperature above room temperature.

14. The substrate of claim 13, wherein the temperature above room temperature

comprises a temperature of approximately 80°C to approximately 600°C.

15. The substrate of claim 1, wherein the expansion or contraction of the lattice constant accommodates material epitaxial growth.

16. (canceled)

17. (canceled)

18. (canceled)

19. (canceled)

20. (canceled)

21. (canceled)

22. (canceled)

23. (canceled)

24. (canceled)

25. (canceled)

26. (canceled)

27. (canceled)

28. (canceled)

29. (canceled)

30. (canceled)

31. (canceled)

32. (canceled)

33. (canceled)

34. (canceled)

35. An optoelectronic apparatus, comprising:

(a) a substrate comprising:

(1) a base substrate;

(2) an interfacial bonding layer disposed on the base substrate; and

(3) a thin film adaptive crystalline layer disposed on the interfacial bonding layer,

wherein:

the interfacial bonding layer is solid at approximately room temperature, and in liquid-like form when above room temperature;

the thin film adaptive crystalline layer has a degree of flexibility to expand or contract its lattice constant along a direction parallel to a surface of the substrate when the interfacial bonding layer is in liquid-like form; and

the base substrate is mechanically strong enough to support the interfacial bonding layer and the thin film adaptive crystalline layer thereon; and

(b) an optoelectronic device epitaxially grown on the thin film adaptive crystalline layer.

36. The optoelectronic apparatus of claim 35, wherein the optoelectronic device is a semiconductor laser.

37. (canceled)

38. (canceled)

sub 31  
39. (new) The substrate of claim 1, wherein the interfacial bonding layer has a finite thickness sufficient to provide the thin film adaptive crystalline layer with said degree of flexibility when the interfacial bonding layer is in liquid-like form and the interfacial bonding layer is thin enough that its surface tension will not destroy the thin film adaptive crystalline layer when the interfacial bonding layer is in liquid-like form.

40. (new) The optoelectronic apparatus of claim 35, wherein the interfacial bonding layer has a finite thickness sufficient to provide the thin film adaptive crystalline layer with said degree of flexibility when the interfacial bonding layer is in liquid-like form and the interfacial bonding layer is thin enough that its surface tension will not destroy the thin film adaptive crystalline layer when the interfacial bonding layer is in liquid-like form.

41. (new) The optoelectronic apparatus of claim 35, wherein the thin film adaptive crystalline layer comprises approximately the same crystalline lattice structure as  $\text{In}_x(\text{Al}_y\text{Ga}_{1-y})_{1-x}\text{As}$ , wherein  $x$  is approximately 15% to approximately 45%.

42. (new) The optoelectronic apparatus of claim 35, wherein above room temperature comprises a temperature of approximately 80°C to approximately 600°C.

43. (new) The optoelectronic apparatus of claim 35, wherein the thin film adaptive crystalline layer comprises InGaAs with an In composition between approximately 15% and approximately 45%.

44. (new) The optoelectronic apparatus of claim 35, wherein the interfacial bonding layer comprises multiple thin metal films, wherein some of the films comprise liquid-like form at a temperature above room temperature, and some of the films remain solid at the temperature above room temperature.

45. (new) The optoelectronic apparatus of claim 35, wherein the expansion or contraction of the lattice constant accommodates material epitaxial growth.